π^3 Course: Introduction to Deep Learning, PyTorch and TorchPhysics (A3)

Further Information - First Part of the Course

RTG 2224

July 17-18, 2023

Dr. Daniel Otero Baguer

General Information

Background

The course is thought for anyone interested on deep learning and industry applications. It is also a good introduction to the field and specially to the PyTorch deep learning library. In this course the participants will really have hands on and build their own neural networks, not only for typical computer vision tasks, but also for solving more complex problems such as obtaining computer tomography reconstructions.

Contents

- Introduction to training neural networks with PyTorch
- Model-based classic approaches, e.g., ISTA
- Introduction to data-based methods, e.g., LISTA
- Neural Networks for trivial ill-posed inverse problems and fully data-based methods
- Combining model and data-based methods: learned post-processing and learned gradient descent
- Deep Image Prior and mathematical aspects
- Applications on Computed Tomography (CT)

Learning Objectives

At the end of the course the participants will have a good understanding of how neural networks work, and also the mathematical theory behind it. They will also be able to program deep learning approaches themselves using Python and the PyTorch library.

Prior Knowledge

Some experience in programming in Python needed.

Technical Requirements

- Own Laptop
- Connection to the Wifi of the University Bremen via eduroam (see https://www.uni-bremen.de/en/zfn/wifi/instructions-wifi for more information)
- Google Colab (https://colab.research.google.com/)

PDF Slides

- Introductory slides for convolutional neural networks, data augmentation and transfer learning can be found in https://github.com/oterobaguer/rtg-pi3-deep-learning/blob/master/slides_daniel.pdf.
- PDF slides for data driven approaches for neural networks can be found in https://github.com/oterobaguer/rtg-pi3-deep-learning/blob/master/inverse_problems_data_driven.pdf.

Further Questions

In case of any questions, please write an email to otero@uni-bremen.de. You can also find in https://github.com/oterobaguer/rtg-pi3-deep-learning more information on an earlier Deep Learning course.

Installation Instructions

Google Colab Instructions

1. Create a Google Account

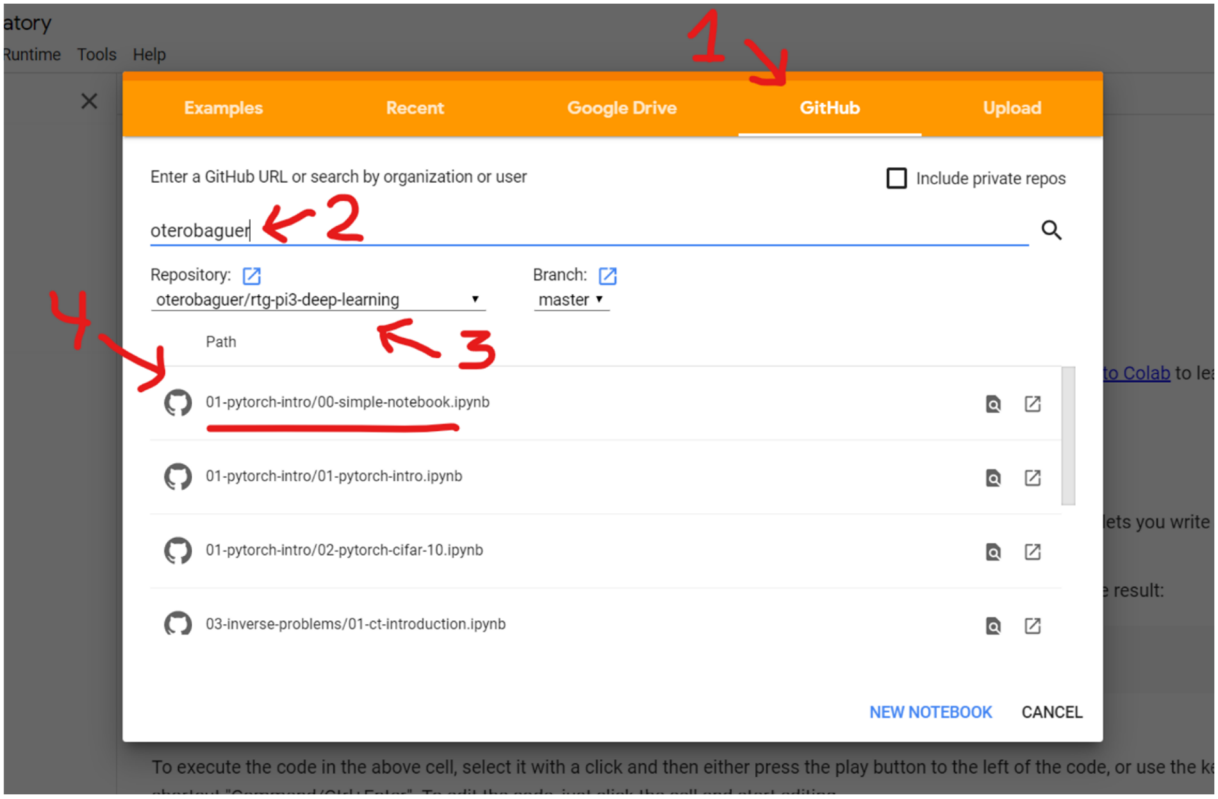
You need a Google account for using Colab.

2. Create a Google Account

Go to https://colab.research.google.com.

3. Get the Notebooks

Select the GITHUB tab (1) and type `oterobaguer` (2). Then select the `rtg-pi3-deep-learning` (3) repository (master branch) and try the `00-simple-notebook` (4) to verify that it works.



Local Installation Instructions

We strongly recommend to use Google Colab, specially because the data will be stored in Google Drive, which can be accessed directly from Google Colab without having to download it. In case you want to use your local environment, you will have to download the dataset (approx. 10Gb).

1. Create Folder for the Exercises

If you are using Git, then this happens automatically when you clone the repository, otherwise download a .zip file with the content of the repository and uncompress it. Be careful that you don't lose your own solutions when updating the folder!

2. Install Python

For the exercises we are going to use Python (we recommend to use the Miniconda distribution).

The installer files for all platforms (Windows, Linux, Mac) can be found in:
https://docs.conda.io/en/latest/miniconda.html

Please download the installer and run it.

- If your computer has a 64-bit operating system (most likely) select the 64-bit installer for Python 3.7.
- If your system has a 32-bit operating system (unlikely) you will need to install the 32-bit installer for Python 3.7.
- If you get asked if you want to add the Miniconda directory to the `PATH` select yes.

Confirm that you have successfully installed Miniconda by opening a console and typing `conda`. If an error appears then Conda was not added to the `PATH`. You have to search for the *Anaconda Prompt* terminal and open it. Then you have to change the directory the terminal is pointing to, using for example `cd local_folder\local_folder2`, to the directory that contains the exercises.

3. Install Required Packages

1. Open a console on the folder where you have the repo and create a virtual environment by running `conda create --name dl_intro`.
2. Activate the environment with the command `conda activate dl_intro`.
3. The list of required packages is contained in the file `requirements.txt`, which you can find in https://github.com/oterobaguer/rtg-pi3-deep-learning/blob/master/requirements.txt. Install all of them by running the command `conda install --file requirements.txt`.
4. Install `pytorch`. If you have a supported Nvidia GPU on your system run `conda install pytorch torchvision cudatoolkit=9.0 -c pytorch`. Otherwise just run `conda install pytorch torchvision -c pytorch`.

4. Run Jupyter Notebook

When everything is installed open a terminal on the exercises folder and run `jupyter notebook`.

5. Remarks

The Jupyter Notebooks in the repository are designed to work in Google Colab, if you want to use them locally you might need to do some changes.